



Research Paper

DESIGN AND DEVELOPMENT OF MANUALLY ENERGIZED WATER DISTILLATION DEVICE

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There is almost no water left on earth that is safe to drink without purification after 20-25 years from today. This is a seemingly bold statement, but it is unfortunately true. Only 1% of Earth's water is in a fresh, liquid state, and nearly all of this is polluted by both diseases and toxic chemicals. For this reason, purification of water supplies is extremely important. Keeping these things in mind, we have designed a model which will convert the dirty/saline water into pure/potable water using the renewable source of energy (i.e., Human power). The machine consists of a human-powered flywheel motor using a bicycle-drive mechanism with speed-increasing gearing and a flywheel, which drive the process unit through a spiral jaw clutch and torque increasing gearing. The operator puts energy into the flywheel at a convenient power level for about one minute. After enough energy is stored, pedaling is stopped and the energy in the flywheel is made available to the process unit. Pedal power is the transfer of energy from a human source through the use of a foot pedal and crank system. This technology is most commonly used for transportation and has been used to propel bicycles. Less commonly pedal power is used to power agricultural and hand tools and even to generate electricity by using the generator. This electricity is used for distillation of water in evaporator. The basic mode of the heat transfer involved is convection and The results are obtained by evaporation of the dirty/saline water and fetching it out as pure/drinkable water. The designed model produces 1.5 litres of pure water from 14 litres of dirty water during six hours. The efficiency of plant is 64.37%.

Keywords: Flywheel, Spiral jaw clutch, Distillation

INTRODUCTION

Today fresh water demand is increasing continuously, because of the industrial development, intensified agriculture, improvement of standard of life and increase

of the world population. Only about 3% of the world water is pure and this amount is not evenly distributed on the earth. The supply of pure drinking water is a growing problem for most parts of the world. More than 80 countries,

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which between then have 40% of the world's population are being suffered from this problem.

In order to solve this problem we have designed and developed a device for distillation of water (Figure 1). There are many types of water distillation equipment or devices are widely used due to their conveniences, but this is a new and efficient device for purification of water which takes power from paddling. It doesn't depend upon the electricity because it is operated by human power. With the use of this device we can purify much water for industrial and domestic purpose as well as for rural areas, where electricity and the source of pure water are not available. Development of water distillation device enables the improving availability of pure water. In this device we used manually energized flywheel motor for water distillation. For distillation of water, it is evaporated and passing through the condenser we get the pure water. This pure water is collecting in a container.

Figure 1: Manually Energized Water Distillation Device



NEED FOR MANUALLY ENERGIZED WATER DISTILLATION DEVICE

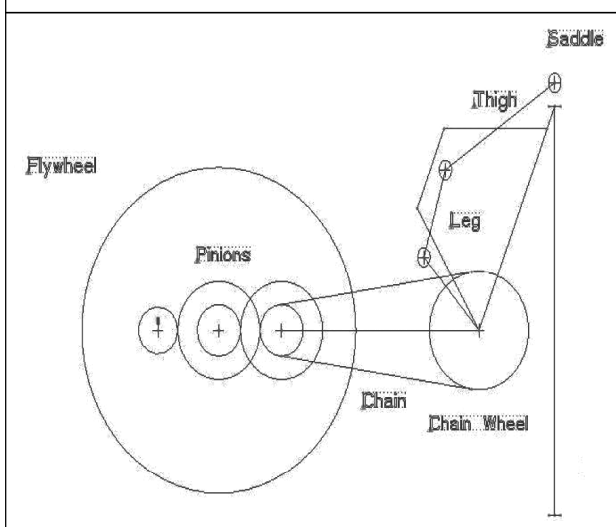
The main objective to design and develop a machine, which uses the human powered flywheel motor as an energy source (Modak and Bapat, 1987); consisting of a bicycle mechanism, use of non-conventional energy as source. Developing countries of third world like India are facing problems of Power storage due to rapid industrialization, nonavailability of power in rural areas and unemployment among semi-skilled workers. In the context of the present condition in India and third world countries the Power shortage and exhaustion of coal reserves and unemployment, it is felt that "Manually energized Chaff Cutter machine" for cutting fodder is very necessary. This machine is environment friendly, i.e., nonpollutant. It will bring Innovation and mechanization in agricultural engineering. Unskilled women may also get employment. Development of such an energy source which has tremendous utility in energizing many rural based process machines in places where reliability of availability of electric energy is much low.

CONCEPT OF MANUALLY ENERGIZED WATER DISTILLATION DEVICE

The average work rate of a man working continuously is equivalent to 0.13 h.p (Modak and Bapat, 1994). Therefore only continuous manufacturing process requiring less than 0.13 h.p. can be man powered. Any manufacturing process requiring more than 0.13 h.p. and which can be operated intermittently without affecting end product can

also be man powered. Such man powered manufacturing process can be based on the following concept. In this processes a flywheel is used as a source of power. Manpower is used to energize the flywheel at an energy input rate, which is convenient for a man. After maximum possible energy is stored in flywheel it is supplied through suitable clutch and gearing system to a shaft, which operates process unit (Modak and Moghe, 1997); the flywheel will decelerate at a rate dependent on load torque. Larger the resisting torque larger will be the deceleration. Thus theoretical a load torque of even infinite magnitude could be overturn by this man-flywheel system (Figure 2).

Figure 2: Energy Unit and Transmission

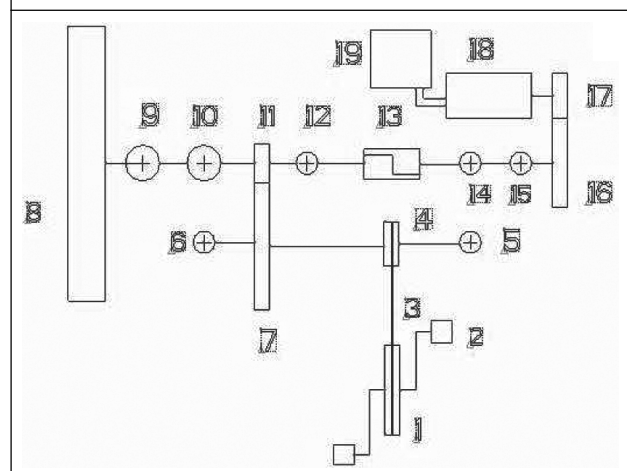


WORKING

1-Chain sprocket, 2-Pedal, 3-Chain, 4-Freewheel, 5 and 6-Bearings for bicycle side, 7-Gear-I, 8-Flywheel, 9 and 10-Bearing for flywheel shaft, 11-Pinion-I, 12-Bearing for flywheel shaft, 13-Two jaw clutch, 14 and 15-Bearings of intermediate shaft, 16-Gear-II, 17-Pinion-II, 18-Generator, 19-Process unit. Essentially, the machine consists of three sub-systems: (1) the energy unit, (2) transmission

mechanism, (3) the process unit. The energy unit consists of a conventional bicycle mechanism, the transmission unit consists of a drive train; a chain drive mechanism running over a pair of speed-increasing gears and the process unit. The schematic arrangement of manually energized water distillation device is shown in Figure 3. The operator drives the flywheel (8). The rider accelerates the flywheel to a desired speed in about one minute, through a chain (3) and a pair of gears (7 and 11). The chain drive is utilized for first stage transmission because the drive is required to be irreversible, this is achieved by conventional bicycle chain drive with a free wheel (4). A free wheel is used between pedals (2) and the flywheel to prevent the back flow of energy from flywheel to pedals. When flywheel attains desired speed, pedaling is stopped and it is connected to the process unit through torque amplification gears by engaging a two jaw spiral clutch (13). A special jaw clutch is used in this machine in place of conventional friction clutch as friction clutch consumes more energy for its own operation. The energy stored in flywheel is supplied at the required rate to

Figure 3: Schematic Diagram of Manually Energized Water Distillation Device



generator (18) and the electricity produced by it is used for water distillation.

DESIGN ANALYSIS

Design of an Experimental set-up is subdivide into five major parts as under (Figure 4):

1. Flywheel design
2. Gear design
3. Shaft design
4. Bearing design
5. Clutch design

Figure 4: Process Unit



RESULTS AND DISCUSSION

A simple, easy to maintain and pedal operated distillation device was developed, constructed and tested.

In order to find out most efficient, productive way operating the system, the input pedaling rate is set in three stages, viz., 30-50 rpm, 50-70 rpm, 70-90 rpm of paddle. For 30-50 rpm, distillation rate of water observed was slow. The distillation rate found to be 25 minutes per 100 ml of pure water from 500 ml. of dirty water. Average time that subject can maintain the pedaling is 15 minutes. For 70-80 rpm the distillation rate of water was observed to be maximum.

CONCLUSION

In this project we observed that the distillation rate of water is mainly depends on two factors:

1. Properties of water or chemical dissolved in the water.
2. Rate of paddling.

When input pedaling rate is set to 50-70 rpm 100 ml. of pure water requires 15 minutes from 500 ml. of water. So overall 50-70 rpm is much suitable distillation of water. From which we can obtained 100 ml. of pure

Specification of Manually Energized Water Distillation Device

S. No.	Name of Parts	Material	Assembly Position	Standard Size/Design	Quantity
1.	Bicycle Frame	Cast Iron	Attached to Assembly Frame	As per std.	1
2.	Shaft No. 1	SAE 1030	Attached to the Rear Sprocket	Diameter = 25 mm N = 120.93 rpm	1
3.	Shaft No. 2	SAE 1030	Attached to the Flywheel	Diameter = 25 mm N = 397.36 rpm	1
4.	Shaft No. 3	SAE 1030	Attached to the Gear	Diameter = 25 mm 1430.511 rpm	1
5.	Gear 1	SAE 3245	Attached to the Shaft No. 1	Diameter = 240 mm No. of Teeth = 115	1

(Cont.)

S. No.	Name of Parts	Material	Assembly Position	Standard Size/Design	Quantity
6.	Gear 2	SAE 3245	Attached to the Shaft No. 2	Diameter = 73 mm No. of Teeth = 35	1
7.	Gear 3	SAE 3245	Attached to the Shaft No. 3	Diameter = 180 mm No. of Teeth = 72	1
8.	Gear 4	SAE 3245	Attached to the Generator	Diameter = 50 mm No. of Teeth = 20	1
9.	Ball Bearing	As per Std.	Placed Inside the Bearing Block	Bearing No. UCP- 205	8
10.	Flywheel	Cast Iron	Attached to Shaft No. 2	D = 300 mm, w = 100, t = 30 mm, N = 397.36	1
11.	Clutch	Mild Steel	Attached to Shaft No. 2 and 3	d = 25 mm	1
12.	Small Sprocket	As per Std.	Attached to Shaft No. 2	D = 80 mm	1
13.	Large Sprocket	As per Std.	Attached to Shaft No. 2	D = 193.5 mm	1
14.	Chain	As per Std.	Attached to Small and Large Sprocket	L = 460 mm	1
15.	Generator	As per Std.	Attached to the Assembly Frame	12 V, N = 1400	1
16.	Evaporator-Condenser Unit	As per Std.	Attached to the Assembly Frame		1

water from 500 ml of water which requires 20 minutes. This pedaling rate found more comfortable than other two. 🌀

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